Exercise - I (Conceptual Questions) Build Up Your Understanding

CONCENTRATION TERMS

1. 8 g NaOH is dissolved in one litre of solution. Its molarity is :
(1) 0.8 M (2) 0.4 M (3) 0.2 M (4) 0.1 M

2. If 18 g of glucose is present in 1000 g of solvent, the solution is said to be :
(1) 1 molar (2) 0.1 molar
(3) 0.5 molar (4) 0.1 molal

3. The molarity of a solution of sodium chloride (mol wt. = 58.5) in water containing 5.85 g of sodium chloride in 500 mL of solution is :-
(1) 0.25 (2) 2.0 (3) 1.0 (4) 0.2

4. For preparing 0.1 M solution of H_2SO_4 in one litre, we need H_2SO_4 :
(1) 0.98 g (2) 4.9 g (3) 49.0 g (4) 9.8 g

5. Mole fraction of glycerine($C_3H_5(OH)_3$) in a solution of 36 g of water and 46 g of glycerine is :
(1) 0.46 (2) 0.36 (3) 0.20 (4) 0.40

6. 1000 g aqueous solution of $CaCO_3$ contains 10 g of calcium carbonate, concentration of the solution is :
(1) 10 ppm (2) 100 ppm
(3) 1000 ppm (4) 10,000 ppm

7. What is the normality of 1M H_3PO_4 solution ?
(1) 0.5 N (2) 1.0 N (3) 2.0 N (4) 3.0 N

8. The molarity of 0.2 N Na_2CO_3 solution will be:
(1) 0.05 M (2) 0.2 M (3) 0.1 M (4) 0.4 M

9. Normality of 0.3 M phosphorous acid is:-
(1) 0.15 (2) 0.6 (3) 0.9 (4) 0.1

10. The molarity of pure water is :
(1) 100 M (2) 55.5 M (3) 50 M (4) 18M

11. Molarity of 720 g of pure water -
(1) 40M
(2) 4M
(3) 55.5M
(4) Can't be determined

12. Equal weight of NaCl and KCl are dissolved separately in equal volumes of solutions then molarity of the two solutions will be –
(1) Equal
(2) That of NaCl will be less than that of KCl
(3) That of NaCl will be more than that of KCl Solution
(4) That of NaCl will be half of that of KCl solution

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13. The mole fraction of oxygen in a mixture of 7g of nitrogen and 8g of oxygen is :
(1) $\frac{8}{15}$ (2) 0.5 (3) 0.25 (4) 1.0

14. In a solution of 7.8 g benzene (C_6H_6) and 46.0g toluene ($C_6H_5CH_3$), the mole fraction of benzene is:-
(1) $\frac{1}{6}$ (2) $\frac{1}{5}$ (3) $\frac{1}{2}$ (4) $\frac{1}{3}$

15. An X molal solution of a compound in benzene has mole fraction of solute equal to 0.2. The value of X is:-
(1) 14 (2) 3.2 (3) 1.4 (4) 2

16. A 500 g tooth paste sample has 0.02 g fluoride concentration. What is the concentration of fluorine in terms of ppm level:-
(1) 250 (2) 40 (3) 400 (4) 1000

17. The normality of 10 mL of a '20 V' H_2O_2 solution is
(1) 1.79 (2) 3.58
(3) 60.86 (4) 6.086

18. H_2O_2 solution used for hair bleaching is sold as a solution of approximately 5.0 g H_2O_2 per 100 mL of the solution. The molecular mass of H_2O_2 is 34. The molarity of this solution is approximately:-
(1) 0.15 M (2) 1.5 M (3) 3.0 M (4) 3.4 M

19. Normality of 10% (w\V) H_2SO_4 solution is nearly
(1) 0.1 (2) 0.2 (3) 0.5 (4) 2

20. What volume of 0.1 N HNO_3 solution can be prepared from 6.3 g of HNO_3 ?
(1) 1 litre (2) 2 litre
(3) 0.5 litre (4) 5 litre

21. A molal solution is one that contains one mole of a solute in
(1) 1000 g of the solvent
(2) one litre of the solution
(3) one litre of the solvent
(4) 22.4 litres of the solution

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22. Which of the following statement is true :-
(a) Molarity is the no. of moles of solute dissolved per litre of solvent.
(b) The molarity and normality of a solution of sodium carbonate are same.
(c) Molality (m) of a solution is defined as the number of moles of solute dissolved is 1000 gm of solution
(d) The ratio of mole fraction of solute and solvent is in the ratio of their respective moles.
(1) a & c (2) a & d
(3) b & c (4) Only d

23. Two bottles of A and B contain 1M and 1m aqueous solution of sulphuric acid respectively-
(1) A is more concentrated than B
(2) B is more concentrated than A
(3) Concentration of A = concentration of B
(4) It is not possible to compare the concentration

24. Molar concentration of a solution in water is :
(1) Always equal to normality
(2) More than molality of the solution
(3) Equal to molality of the solution
(4) Less than the molality of the solution

25. The molarity of 98% (w/W) H_2SO_4 ($d = 1.8\ g\ mL^{-1}$) is :-
(1) 6 M (2) 18 M (3) 10 M (4) 4 M

SOLUBILITY (HENRY'S LAW)

26. Henry's law constant for dissolution of CH_4 in benzene at 298 K is 2×10^5 mm of Hg. Then solubility of CH_4 in benzene at 298 K (in terms of mole fraction) under 760 mm of Hg is :
(1) 1.2×10^{-5} (2) 3.8×10^{-3}
(3) 4×10^{-7} (4) 1×10^{-2}

27. Which of the following gas does not obey Henry's law ?
(1) NH_3 (2) H_2 (3) O_2 (4) He

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VAPOUR PRESSURE (LIQUID-LIQUID MIXTURE)

28. 1 mol of heptane (V. P. = 92 mm of Hg) was mixed with 4 mol of octane (V. P. = 31mm of Hg). The vapour pressure of resulting ideal solution is :
(1) 46.2 mm of Hg (2) 40.0 mm of Hg
(3) 43.2 mm of Hg (4) 38.4 mm of Hg

29. At 88 °C benzene has a vapour pressure of 900 torr and toluene has a vapour pressure of 360 torr. What is the mole fraction of benzene in the mixture with toluene that will boil at 88 °C at 1 atm. pressure, (benzene - toluene form an ideal solution) :
(1) 0.416 (2) 0.588
(3) 0.688 (4) 0.740

30. If P_A^0 and P_B^0 are 108 and 36 torr respectively. What will be the mole fraction of A in vapour phase if B has mole fraction of 0.5 in solution :-
(1) 0.25 (2) 0.75 (3) 0.60 (4) 0.35

31. What is correct relation between mole fraction in vapour phase (Y_A) of A in terms of X_A. If mole fraction in solution of A is (X_A) (If P_A^0 is vapour pressure of A in pure state)
(1) $(1-X_A)P_A^0$ (2) $\frac{X_A}{1-X_A}P_A^0$
(3) $\frac{1-X_A}{X_A}P_A^0$ (4) $\frac{P_A^0 X_A}{P_S}$

IDEAL AND NON-IDEAL SOLUTIONS

32. Which condition is not satisfied by an ideal solution
(1) $\Delta H_{mixing} = 0$
(2) $\Delta V_{mixing} = 0$
(3) $\Delta S_{mixing} = 0$
(4) Obeyance of Raoult's law

33. Among the following, that does not form an ideal solution is :
(1) C_6H_6 and $C_6H_5CH_3$
(2) C_2H_5Cl and C_6H_5OH
(3) C_6H_5Cl and C_6H_5Br
(4) C_2H_5Br and C_2H_5I

34. An azeotropic mixture of two liquids has boiling point lower than either of them when it :-
(1) Shows a (+ve) deviation from Raoult's law
(2) Shows no deviation from Raoult's law
(3) Shows (+ve) deviation from Henry's law
(4) Shows (–ve) deviation from Henry's law

COLLIGATIVE PROPERTIES

35. Which is not a colligative property ?
(1) Osmotic pressure
(2) Relative lowering in vapour pressure
(3) Depression in freezing point
(4) Refractive index

36. The lowering of vapour pressure of a solvent by addition of a non-volatile solute to it, is directly proportional to :
(1) Mole fraction of solute
(2) The nature of the solute in the solution
(3) The atmospheric pressure
(4) All

37. The relative lowering of vapour pressure is equal to the mole fraction of the nonvolatile solute. This statement was given by :
(1) Raoult (2) Henry
(3) Joule (4) Dalton

38. The vapour pressure of a solution having solid as solute and liquid as solvent is :
(1) Directly proportional to mole fraction of the solvent
(2) Inversely proportional to mole fraction of the solvent
(3) Directly proportional to mole fraction of the solute
(4) Inversely proportional to mole fraction of the solute

39. If P_0 and P_S are the vapour pressure of solvent and its solution respectively. N_1 and N_2 are the mole fraction of solvent and solute respectively then :
(1) $P_S = \frac{P_0}{N_2}$
(2) $P_0 - P_S = P_0N_2$
(3) $P_S = P_0N_2$
(4) $\frac{(P_0 - P_S)}{P_S} = \frac{N_1}{(N_1 + N_2)}$

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40. One mole of non volatile solute is dissolved in two mole of water. The vapour pressure of the solution relative to that of water is
(1) $\frac{2}{3}$ (2) $\frac{1}{3}$ (3) $\frac{1}{2}$ (4) $\frac{3}{2}$

41. The vapour pressure of a dilute aqueous solution of Glucose is 750 mm Hg at 373 K. The mole fraction of solute is :
(1) $\frac{1}{10}$ (2) $\frac{1}{7.6}$ (3) $\frac{1}{35}$ (4) $\frac{1}{76}$

42. The vapour pressure of water at room temperature is 23.8 mm of Hg. The vapour pressure of an aqueous solution of sucrose with mole fraction 0.1 is equal to :
(1) 23.9 mm Hg (2) 24.2 mm Hg
(3) 21.42 mm Hg (4) 31.44 mm Hg

43. The vapour pressure of pure A is 10 torr. At the same temperature, when 1 g of B is dissolved in 20 gm of A, its vapour pressure is reduced to 9.0 torr. If the molecular mass of A is 200 amu, then the molecular mass of B is :
(1) 100 amu (2) 90 amu
(3) 75 amu (4) 120 amu

44. The boiling point of C_6H_6, CH_3OH, $C_6H_5NH_2$ and $C_6H_5NO_2$ are 80°C, 65°C, 184°C and 212°C respectively. Which will show highest vapour pressure at room temperature :
(1) C_6H_6 (2) CH_3OH
(3) $C_6H_5NH_2$ (4) $C_6H_5NO_2$

45. If Raoult's law is obeyed, the vapour pressure of the solvent in a solution is directly proportional to :
(1) Mole fraction of the solvent
(2) Mole fraction of the solute
(3) Mole fraction of the solvent and solute
(4) The volume of the solution

46. The vapour pressure of a pure liquid 'A' is 70 torr at 27°C. It forms an ideal solution with another liquid B. The mole fraction of B is 0.2 and total vapour pressure of the solution is 84 torr at 27°C. The vapour pressure of pure liquid B at 27°C is -
(1) 14 (2) 56 (3) 140 (4) 70

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47. The boiling point of an aqueous solution of a non volatile solute is 100.15 °C. What is the freezing point of an aqueous solution obtained by diluting the above solution with an equal volume of water? The values of K_b and K_f for water are 0.512 and 1.86 K molality^{-1} :

(1) –0.544 °C (2) –0.512 °C

(3) –0.272 °C (4) –1.86 °C

48. The molal elevation constant is the ratio of the elevation in B.P. to :

(1) Molarity

(2) Molality

(3) Mole fraction of solute

(4) Mole fraction of solvent

49 Elevation in boiling point was 0.52 °C when 6 g of a compound X was dissolved in 100 g of water. Molecular weight of X is : (Kb for water = 0.52 K mol^{-1})

(1) 120 (2) 60 (3) 100 (4) 342

50. An aqueous solution containing 1g of urea boils at 100.25 °C. The aqueous solution containing 3g of glucose in the same volume will boil at -

(1) 100.75 °C (2) 100.5 °C

(3) 100 °C (4) 100.25 °C

51. Pure benzene freezes at 5.45 °C at a certain place but a 0.374 m solution of tetrachloroethane in benzene freezes at 3.55 °C. The K_f for benzene is-

(1) 5.08 K Kg mol^{-1}

(2) 508 K Kg mol^{-1}

(3) 0.508 K Kg mol^{-1}

(4) 50.8 °C Kg mol^{-1}

52. An aqueous solution freezes at – 0.186 °C (K_f = 1.86 K kg mol^{-1} ; K_b = 0.512 K kg mol^{-1}). What is the elevation in boiling point ?

(1) 0.186 (2) 0.512

(3) $\frac{0.512}{1.86}$ (4) 0.0512

53. In the depression of freezing point experiment, it is found that :-

(1) The vapour pressure of solution is more than of pure H_2O.

(2) The vapour pressure of solution is less than that of pure solute

(3) Only solute molecules solidify at of freezing point

(4) Only solvent molecules solidify at freezing point

54. Molal depression constant of water is 1.86 K Kg mol^{-1} . 0.02 mole of urea dissolved in 100 g of water will produce a depression in freezing point of :

(1) 0.186 °C (2) 0.372 °C

(3) 1.86 °C (4) 3.72 °C

55. What would be the freezing point of aqueous solution containing 18 g of $C_6H_{12}O_6$ in 1000 g of water ? (K_f = 1.86 K molality^{-1})

(1) –0.186° C (2) –0.372° C

(3) –0.54° C (4) –0.72° C

56. A solution of 1.25 g of a non-electrolyte in 20 g of water freezes at 271.94 K. If K_f = 1.86K molality^{-1} and F.pt. of water is 273.15 K then the molar mass of solute is :

(1) 207.8 g mol^{-1} (2) 179.79 g mol^{-1}

(3) 209.6 g mol^{-1} (4) 96.01 g mol^{-1}

57. If a thin slice of sugar beet is placed in concentrated solution of NaCl then

(1) Sugar beet will lose water from its cells

(2) Sugar beet will absorb water from solution

(3) Sugar beet will neither absorb nor lose water

(4) Sugar beet will dissolve in solution

58. In osmosis phenomenon net flow of :

(1) Solvent molecules occurs from higher concentration to lower concentration

(2) Solvent molecules occurs from lower concentration to higher concentration

(3) Solute molecules occurs from higher concentratioin to lower concentration

(4) Solute molecules occurs from lower concentration to higher concentration

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59. At constant temperature, the osmotic pressure of a solution is :
(1) Directly proportional to the concentration
(2) Inversely proportional to the concentration
(3) Directly proportional to the square of concentration
(4) Directly proportional to the square root of concentration

60. Which inorganic compounds can act as semipermeable membrane ?
(1) Calcium sulphate
(2) Barium oxalate
(3) Nickel phosphate
(4) Copper ferrocyanide

61. If 0.1 M solution of glucose and 0.1 M urea solution are placed on two sides of a semipermeable membrane to equal heights, then it will be correct to say that :
(1) There will be no net movement across the membrane
(2) Glucose will flow towards urea solution
(3) Urea will flow towards glucose solution
(4) Water will flow from urea solution towards glucose solution.

62. If mole fraction of the solvent in solution decreases then :
(1) Vapour pressure of solution increases
(2) B. P. decreases
(3) Osmotic pressure increases
(4) All are correct

63. The osmotic pressure of a solution increases if :
(1) Temperature is lowered
(2) Volume is increased
(3) Number of solute molecules is increased
(4) None

64. Which of the following solutions at the same temperature will be isotonic :
(1) 3.42 g of cane sugar in one litre water and 0.18 g of glucose in one litre water.
(2) 3.42 g of cane sugar in one litre water and 0.18 g of glucose in 0.1 litre water.
(3) 3.42 g of cane sugar in one litre water and 0.585g of NaCl in one litre water.
(4) 3.42 g of cane sugar in one litre water and 1.17 g of NaCl in one litre water.

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65. If density of 2 molal sucrose solution is 1.4 g mL^{-1} at 25°C, find osmotic pressure.
(1) 4.06 atm (2) 2 atm
(3) 40.7 atm (4) 3.4 atm

66. If total concentration of dissolved particles inside red blood cells is 0.3 M (approximate) and the membrane surrounding the cell is semipermeable. Find osmotic pressure inside the cell
(1) 7.34 atm (2) 1.78 atm
(3) 2.34 atm (4) 0.74 atm

67. Equal volume of 0.1 M urea and 0.1 M glucose are mixed. The mixture will have :-
(1) Lower osmotic pressure
(2) Same osmotic pressure
(3) Higher osmotic pressure
(4) None of these

68. Osmotic pressure of a solution (density is 1g mL^{-1}) containing 3 g of glucose (molecular weight = 180) in 60 g of water at 15°C is :
(1) 0.34 atm (2) 0.65 atm
(3) 6.25 atm (4) 5.57 atm

69. Osmotic pressure of a sugar solution at 24°C is 2.5 atm. The concentration of the solution in mole per litre is :
(1) 10.25 (2) 1.025
(3) 1025 (4) 0.1025

70. A solution containing 8.6 g urea in one litre was found to be isotonic with 0.5% (wt./vol) solution of an organic non volatile solute. The molecular weight of organic solute is :
(1) 348.9 (2) 34.89 (3) 3489 (4) 861.2

71. If 6.84% (w/V) solution of cane-sugar (mol. wt. 342) is isotonic with 1.52% (w/V) solution of thiocarbamide, then the molecular weight of thiocarbamide is :
(1) 152 (2) 76 (3) 60 (4) 180

72. A solution containing 500 g of a protein per litre is isotonic with a solution containing 3.42 g of sucrose per litre. The molecular mass of protein is
(1) 5 (2) 146 (3) 34200 (4) 50000

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73. ___(A)___ injection are dissolved in water containing salts at particular ___(B)___ concentrations that matches ___(C)___ concentration. Here A, B and C refer to :
(1) Intravenous, ionic, blood plasma
(2) Intravenous, blood plasma, ionic
(3) Blood plasma, intravenous, ionic
(4) Blood plasma, ionic, intravenous

ABNORMAL COLLIGATIVE PROPERTIES

74. Equimolal solutions of A and B show depression in freezing point in the ratio of 2 : 1. If a remains in normal state in solution, B will be in ..... state in solution :
(1) Normal (2) Associated
(3) Hydrolysed (4) Dissociated

75. Vant Hoff factor is :
(1) Less than one in case of dissociation
(2) More than one in case of association
(3) Always less than one
(4) Less than one in case of association

76. The vant Hoff factor (i) for a dilute solution of $K_3[Fe(CN)_6]$ is :
(1) 10 (2) 4 (3) 5 (4) 0.25

77. The experimental molecular weight of an electrolyte will always be less than its calculated value because the value of vant Hoff factor, 'i' is :
(1) Less than 1 (2) Greater than 1
(3) One (4) Zero

78. The vant Hoff factor (i) for a dilute aqueous solution of Glucose is :
(1) Zero (2) 1.0 (3) 1.5 (4) 2.0

79. Osmotic pressure of 0.585% w/v NaCl solution at 27°C is.
(1) 2.49 atm (2) 4.92 atm
(3) 1.2 atm (4) 3.8 atm

80 The substance A when dissolved in solvent B shows the molecular mass corresponding to A_3. The vant Hoff's factor will be -
(1) 1 (2) 2 (3) 3 (4) $\frac{1}{3}$

81. The ratio of the value of any colligative property for KCl solution to that for sugar solution is nearly ..... time :
(1) 1 (2) 0.5 (3) 2 (4) 2.5

82. The lowering of vapour pressure of 0.1M aqueous solutions of NaCl, $CuSO_4$ and K_2SO_4 are:
(1) All equal
(2) In the ratio of 1 : 1 : 1.5
(3) In the ratio of 3 : 2 : 1
(4) In the ratio of 1.5 : 1 : 2.5

83. The freezing point of 1 molal NaCl solution assuming NaCl to be 100% dissociated in water is: (K_f = 1.86 K Molality^{-1})
(1) –1.86°C (2) –3.72°C
(3) +1.86°C (4) + 3.72°C

84. The molal elevation constant of water is 0.51. The boiling point of 0.1 molal aqueous NaCl solution is nearly :
(1) 100.05°C (2) 100.1°C
(3) 100.2°C (4) 101.0°C

85. Phenol associates in benzene as

$$C_6H_5OH \rightleftharpoons \frac{1}{2}(C_6H_5OH)_2$$

If degree of association of phenol is 40%, Van't Hoff factor i is :-
(1) 1 (2) 0.8 (3) 1.4 (4) 0.6

86. The values of observed and calculated molecular weight of calcium nitrate are respectively 65.6 and 164. The degree of dissociation of calcium nitrate will be :
(1) 25% (2) 50% (3) 75% (4) 60%

87. A 0.004M solution of Na_2SO_4 is isotonic with a 0.010M solution of glucose at the 25°C temperature. The degree of dissociation of Na_2SO_4 is
(1) 25% (2) 50% (3) 75% (4) 85%

88. A 5.8% (wt./vol.) NaCl solution will exert an osmotic pressure closest to which one of the following :
(1) 5.8% (wt./vol) sucrose solution
(2) 5.8% (wt./vol) glucose solution
(3) 2 M sucrose solution
(4) 1 M glucose solution

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89. Which salt shows maximum osmotic pressure in its 1M solution :
(1) $AgNO_3$ (2) Na_2SO_4
(3) $(NH_4)_3PO_4$ (4) $MgCl_2$

90. Which solution will exert highest osmotic pressure?
(1) 1M glucose solution
(2) 1M urea solution
(3) 1M Alum solution
(4) 1M NaCl solution

91. Which is the correct relation between osmotic pressure of 0.1M NaCl solution and 0.1M Na_2SO_4 solution ?
(1) The osmotic pressure of Na_2SO_4 is less than NaCl solution
(2) The osmotic pressure Na_2SO_4 is more than NaCl solution
(3) Both have same osmotic pressure
(4) None of the above

92. Which one of the following solutions will have highest osmotic pressure ? (Assume that all the salts are equally dissociated)
(1) 0.1M $Al_2(SO_4)_3$
(2) 0.1M $BaCl_2$
(3) 0.1 M Na_2SO_4
(4) The solution obtained by mixing equal volumes of (2) and (3)

93. The following solutions have equal concentrations. Which one will show minimum osmotic pressure?
(1) $BaCl_2$ (2) $AgNO_3$
(3) Na_2SO_4 (4) $(NH_4)_3PO_4$

94. The osmotic pressure of equimolar solutions of $BaCl_2$, NaCl, and glucose will be in the order:
(1) Glucose > NaCl > $BaCl_2$
(2) $BaCl_2$ > NaCl > Glucose
(3) NaCl > $BaCl_2$ > Glucose
(4) NaCl > Glucose > $BaCl_2$

95. Which one of the following pairs of solutions will be expected to be isotonic under the same temperature ?
(1) 0.1M urea and 0.1 M NaCl
(2) 0.1M urea and 0.2 M $MgCl_2$
(3) 0.1M NaCl and 0.1M Na_2SO_4
(4) 0.1M $Ca(NO_3)_2$ and 0.1M Na_2SO_4

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96. Two solutions of KNO_3 and CH_3COOH are prepared separately. Molarity of both is 0.1M and osmotic pressures are P_1 and P_2 respectively. The correct relationship between the osmotic pressures is
(1) $P_2 > P_1$ (2) $P_1 = P_2$
(3) $P_1 > P_2$ (4) $\frac{P_1}{P_1+P_2} = \frac{P_2}{P_1+P_2}$

97. The correct relationship between the boiling points of dilute solutions of $AlCl_3(T_1)$ and $CaCl_2(T_2)$, having the same molar concentration is :
(1) $T_1 = T_2$ (2) $T_1 > T_2$
(3) $T_2 = T_1$ (4) $T_2 \geq T_1$

98. Which of the following 0.1 M aqueous solutions will have the lowest freezing point :
(1) Potassium Sulphate
(2) Sodium Chloride
(3) Urea
(4) Glucose

99. Which aqueous solution has minimum freezing point?
(1) 0.01 M NaCl (2) 0.005 M C_2H_5OH
(3) 0.005 M MgI_2 (4) 0.005 M $MgSO_4$

100. If α is the degree of dissociation of $K_4[Fe(CN)_6]$, then abnormal mass of complex in the solution will be :-
(1) $M_{normal}\,(1+2\alpha)^{-1}$ (2) $M_{normal}\,(1+3\alpha)^{-1}$
(3) $M_{normal}\,(1+\alpha)^{-1}$ (4) $M_{normal}\,(1+4\alpha)^{-1}$

101. Which solution will have least vapour pressure :
(1) 0.1 M $BaCl_2$ (2) 0.1 M urea
(3) 0.1 M Na_2SO_4 (4) 0.1 M Na_3PO_4

102. Which has maximum freezing point :
(1) 1M of NaCl solution (2) 1M of KCl solution
(3) 1M of $CaCl_2$ solution (4) 1M of urea solution

103. The freezing point of 1% w/w aqueous solution of calcium nitrate will be :
(1) 0^0C (2) Above 0^0C
(3) 1^0C (4) Below 0^0C

104. The following aqueous solution in the correct order of decreasing freezing point is -
(1) 0.2M $BaCl_2$, 0.2M KCl, 0.1M Na_2SO_4
(2) 0.2M KCl, 0.1M Na_2SO_4, 0.2M $BaCl_2$
(3) 0.1M Na_2SO_4, 0.2M KCl, 0.2M $BaCl_2$
(4) 0.1M Na_2SO_4, 0.2M $BaCl_2$, 0.2M KCl

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105. Which of the following solutions will have highest boiling point ?
(1) 1% w/w Glucose in water
(2) 1% w/w NaCl in water
(3) 1% w/w $Ca_3(PO_4)_2$ in water
(4) 1% w/w Urea in water

106. The freezing point of equimolal aqueous solution will be highest for :
(1) Urea (2) $Ca(NO_3)_2$
(3) $Al(NO_3)_3$ (4) $C_6H_{12}O_6$(Glucose)

107. When mercuric Iodide is added to the aqueous solution of potassium iodide ?
(1) The boiling point does not change
(2) Freezing point is raised
(3) The freezing point is lowered
(4) Freezing point does not change

108. The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to :
(1) Ionisation of benzoic acid
(2) Dimerization of benzoic acid
(3) Trimerization of benzoic acid
(4) Solvation of benzoic acid

109. What would be the osmotic pressure of 0.1 M K_2SO_4 solution (90% dissociated) at 27°C :-
(1) 6.89 atm (2) 0.689 atm
(3) 0.344 atm (4) 3.4 atm

110. Which one has same Van't Hoff factor i as that of Hg_2Cl_2 :-
(1) NaCl (2) Na_2SO_4
(3) $Al(NO_3)_3$ (4) $Al_2(SO_4)_3$

EXERCISE-I (Conceptual Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	3	4	4	4	3	4	4	3	2	2	3	3	2	1	2
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	2	2	2	4	1	1	4	1	4	2	2	1	3	4	2
Question	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Answer	4	3	2	1	4	1	1	1	2	1	4	3	2	2	1
Question	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Answer	3	3	2	2	4	1	4	4	2	1	4	1	2	1	4
Question	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Answer	1	3	3	2	3	1	2	3	4	2	2	4	1	2	4
Question	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Answer	2	2	2	2	4	3	2	2	2	2	3	3	3	3	3
Question	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
Answer	2	1	2	2	4	3	2	1	1	4	4	4	4	3	2
Question	106	107	108	109	110										
Answer	1	2	2	1	2										

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Exercise - II (Previous Year Questions) Build Up Your Understanding

AIPMT 2009

1. A 0.0020 m aqueous solution of an ionic compound $[Co(NH_3)_5(NO_2)]Cl$ freezes at –0.00732°C. Number of moles of ions which 1mol of ionic compound produces on being dissolved in water will be(K_f = 1.86°C m^{-1}) :-
(1) 1 (2) 2 (3) 3 (4) 4

AIPMT 2010

2. An aqueous solution of KI is 1.00 molal. Which change will cause increase in vapour pressure of the solution ?
(1) Addition of water
(2) Addition of NaCl
(3) Addition of Na_2SO_4
(4) Addition of 100 molal KI

3. A solution of sucrose (molar mass = 342 g mol^{-1}) has been prepared by dissolving 68.5 g of sucrose in 1000 g of water. The freezing point of the solution obtained will be :-
(K_f for water = 1.86 K kg mol^{-1})
(1) –0.570°C (2) –0.372°C
(3) –0.520°C (4) +0.372°C

AIPMT Pre. 2011

4. The freezing point depression constant for water is –1.86°C m^{-1}. If 5 g Na_2SO_4 is dissolved in 45.0 g H_2O, the freezing point is changed by –3.82°C. Calculate the Van't Hoff factor for Na_2SO_4
(1) 2.05 (2) 2.63 (3) 3.11 (4) 0.381

5. The Van't Hoff factor i for a compound which undergoes dissociation in one solvent and association in other solvent is respectively :
(1) Less than one and greater than one
(2) Less than one and less than one
(3) Greater than one and less than one
(4) Greater than one and greater than one

6. Mole fraction of the solute in a 1.00 molal aqueous solution is :
(1) 0.1770 (2) 0.0177
(3) 0.0344 (4) 1.7700

AIPMT Mains 2011

7. 200 mL of an aqueous solution of a protein contain its 1.26 g. The Osmotic pressure of this solution at 300 K is found to be 2.57×10^{-3} bar. The molar mass of protein will be :-
(R = 0.083 L bar mol^{-1} K^{-1})
(1) 61038 g mol^{-1} (2) 51022 g mol^{-1}
(3) 122044 g mol^{-1} (4) 31011 g mol^{-1}

AIPMT Pre 2012

8. p_A and p_B are the vapour pressure of pure liquid components, A and B, respectively of an ideal binary solution. If x_A represents the mole fraction of component A, the total pressure of the solution will be.
(1) $p_B + x_A (p_B - p_A)$ (2) $p_B + x_A (p_A - p_B)$
(3) $p_A + x_A (p_B - p_A)$ (4) $p_A + x_A (p_A - p_B)$

AIPMT Mains 2012

9. Which of the following compounds can be used as antifreeze in automobile radiators ?
(1) Nitrophenol (2) Ethyl alcohol
(3) Methyl alcohol (4) Glycol

10. Vapour pressure of chloroform ($CHCl_3$) and dichloro methane (CH_2Cl_2) at 25°C are 200 mmHg and 415 mmHg respectively. Vapour pressure of the solution obtained by mixing 25.5 g of $CHCl_3$ and 40g of CH_2Cl_2 at the same temperature will be: (Molecular mass of $CHCl_3$ = 119.5 u and molecular mass of CH_2Cl_2 = 85 u)
(1) 347.9 mmHg (2) 280.5 mmHg
(3) 173.9 mmHg (4) 615 mmHg

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NEET-UG 2013

11. 6.02×10^{20} molecules of urea are present in 100mL of its solution. The concentration of solution is :-

(1) 0.1 M (2) 0.02 M (3) 0.01 M (4) 0.001M

AIPMT 2014

12. Of the following 0.10m aqueous solutions, which one will exhibit the largest freezing point depression?

(1) KCl (2) $C_6H_{12}O_6$

(3) $Al_2(SO_4)_3$ (4) K_2SO_4

AIPMT 2015

13. The boiling point of 0.2 mol kg^{-1} solution of X in water is greater than equimolal solution of Y in water. Which one of the following statements is true in this case?

(1) Molecular mass of X is greater than the molecular mass of Y.

(2) Molecular mass of X is less than the molecular mass of Y.

(3) Y is undergoing dissociation in water while X undergoes no change.

(4) X is undergoing dissociation in water while Y undergoes no change.

14. Which one is not equal to zero for an ideal solution:-

(1) ΔS_{mix}

(2) ΔV_{mix}

(3) $\Delta P = P_{observed} - P_{Raoult}$

(4) ΔH_{mix}

15. Which one of the following electrolytes has the same value of van't Hoff's factor (i) as that of the $Al_2(SO_4)_3$ (if all are 100% ionised) ?

(1) $K_3[Fe(CN)_6]$ (2) $Al(NO_3)_3$

(3) $K_4[Fe(CN)_6]$ (4) K_2SO_4

Re-AIPMT 2015

16. What is the mole fraction of the solute in a 1.00 m aqueous solution ?

(1) 0.0354 (2) 0.0177

(3) 0.177 (4) 1.770

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NEET-I 2016

17. Which of the following statement about the composition of the vapour over an ideal a 1 : 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at (25°C). (Given : Vapour Pressure Data at 25°C, benzene = 12.8 kPa, Toluene = 3.85 kPa)

(1) The vapour will contain a higher percentage of benzene

(2) The vapour will contain a higher percentage of toluene

(3) The vapour will contain equal amounts of benezene and toluene

(4) Not enough information is given to make a predication

18. At 100°C the vapour pressure of a solution of 6.5g of a solute in 100 g water is 732 mm. If K_b = 0.52°C m^{-1}, the boiling point of this solution will be :-

(1) 101°C (2) 100°C (3) 102°C (4) 103°C

19. Consider the following liquid - vapour equilibrium.

Liquid $\rightleftharpoons$ Vapour

Which of the following relations is **correct** ?

(1) $\frac{d\ell n G}{dT^2} = \frac{\Delta H_v}{RT^2}$ (2) $\frac{d\ell n P}{dT} = \frac{-\Delta H_v}{RT}$

(3) $\frac{d\ell n P}{dT^2} = \frac{-\Delta H_v}{T^2}$ (4) $\frac{d\ell n P}{dT} = \frac{\Delta H_v}{RT^2}$

NEET-II 2016

20. The van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is

(1) 2 (2) 3 (3) 0 (4) 1

21. Which one of the following is **incorrect** for ideal solution ?

(1) $\Delta P = P_{obs} - P_{calculated\ by\ Raoult's\ law} = 0$

(2) $\Delta G_{mix} = 0$

(3) $\Delta H_{mix} = 0$

(4) $\Delta U_{mix} = 0$

NEET(UG) 2017

22. If molality of a dilute solution is doubled, the value of molal depression constant (Kf) will be:-
(1) Halved (2) Tripled
(3) Unchanged (4) Doubled

23. Which of the following is dependent on temperature?
(1) Molarity (2) Mole fraction
(3) Weight percentage (4) Molality

NEET(UG) 2019

24. For an ideal solution, the **correct** option is :-
(1) Δ_{mix} S = 0 at constant T and P
(2) Δ_{mix} V ≠ 0 at constant T and P
(3) Δ_{mix} H = 0 at constant T and P
(4) Δ_{mix} G = 0 at constant T and P

NEET(UG)(Odisha) 2019

25. Which of the following statements is correct regarding a solution of two compounds A and B exhibiting positive deviation from ideal behaviour?
(1) Intermolecular attractive forces between A-A and B-B are stronger than those between A-B.
(2) Δ_{mix} H = 0 at constant T and P
(3) Δ_{mix} V = 0 at constant T and P
(4) Intermolecular attractive forces between A-A and B-B are equal to those between A-B.

26. The density of 2 M aqueous solution of NaOH is 1.28 g/cm^3. The molality of the solution is [Given that molecular mass of NaOH = 40 g mol^{-1}]
(1) 1.20 m (2) 1.56 m
(3) 1.67 m (4) 1.32 m

NEET (UG) 2020

27. The freezing point depression constant (Kf) of benzene is 5.12 K kg mol^{-1}. The freezing point depression for the solution of molality 0.078 m containing a non-electrolyte solute in benzene is (rounded off upto two decimal places) :
(1) 0.60 K (2) 0.20 K
(3) 0.80 K (4) 0.40 K

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28. The mixture which shows positive deviation from Raoult's law is :-
(1) Chloroethane + Bromoethane
(2) Ethanol + Acetone
(3) Benzene + Toluene
(4) Acetone + Chloroform

NEET (UG) 2020 (COVID-19)

29. If 8g of a non-electrolyte solute is dissolved in 114 g of n-octane to reduce its vapour pressure to 80%, the molar mass (in g mol^{-1}) of the solute is
[Given that molar mass of n-octane is 114 g mol^{-1}]
(1) 40 (2) 60 (3) 80 (4) 20

30. Isotonic solutions have same
(1) Vapour pressure
(2) Freezing temperature
(3) Osmotic pressure
(4) Boiling temperature

NEET (UG) 2021

31. The following solutions were prepared by dissolving 10 g of glucose ($C_6H_{12}O_6$) in 250 ml of water (P_1), 10 g of urea (CH_4N_2O) in 250 ml of water (P_2) and 10 g of sucrose ($C_{12}H_{22}O_{11}$) in 250 ml of water (P_3). The right option for the decreasing order of osmotic pressure of these solutions is :
(1) $P_2 > P_1 > P_3$ (2) $P_1 > P_2 > P_3$
(3) $P_2 > P_3 > P_1$ (4) $P_3 > P_1 > P_2$

32. The correct option for the value of vapour pressure of a solution at 45°C with benzene to octane in molar ratio 3 : 2 is :
[At 45°C vapour pressure of benzene is 280 mm Hg and that of octane is 420 mm Hg. Assume Ideal gas]
(1) 160 mm of Hg (2) 168 mm of Hg
(3) 336 mm of Hg (4) 350 mm of Hg

NEET (UG) 2022

33. In one molal solution that contains 0.5 mole of a solute, there is
(1) 500 g of solvent (2) 100 mL of solvent
(3) 1000 g of solvent (4) 500 mL of solvent

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34. K_H value for some gases at the same temperature 'T' are given :

gas	K_H/k bar
Ar	40.3
CO_2	1.67
HCHO	1.83×10^{-5}
CH_4	0.413

where K_H is Henry's Law constant in water. The order of their solubility in water is :

(1) $Ar < CO_2 < CH_4 < HCHO$

(2) $Ar < CH_4 < CO_2 < HCHO$

(3) $HCHO < CO_2 < CH_4 < Ar$

(4) $HCHO < CH_4 < CO_2 < Ar$

EXERCISE-II (Previous Year Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	2	1	2	2	3	2	1	2	4	1	3	3	4	1	3
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	2	1	1	4	2	2	3	1	3	1	3	4	2	1	3
Question	31	32	33	34											
Answer	1	3	1	1											

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Exercise - III (Analytical Questions) Build Up Your Understanding

1. Given below are two statements; one is labelled as **Assertion (A)** and the other is labelled as **Reason(R)**.

Assertion (A) : Raoult's law is a special case of Henry's law

Reason (R) : According to Raoult's law $P_i = x_i p_i^\circ$ According to Henry's law $P = K_H X$

Here K_H differ from p_i°. In special case K_H becomes equal to p_i°.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**.

(2) **(A)** is correct but **(R)** is not correct.

(3) **(A)** is not correct but **(R)** is correct.

(4) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.

2. Given below are two statements; one is labelled as **Assertion (A)** and the other is labelled as **Reason(R)**.

Assertion (A) : Van't Hoff factor (i) depend on concentration in case of incomplete dissociation.

Reason (R) : For incomplete dissociation of electrolyte, value of Van't Hoff factor(i) increase with decrease in concentration.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A).**

(2) **(A)** is correct but **(R)** is not correct.

(3) **(A)** is not correct but **(R)** is correct.

(4) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A).**

3. Given below are two statements; one is labelled as **Assertion (A)** and the other is labelled as **Reason(R)**.

Assertion (A) : Cooking time is reduced in pressure cooker.

Reason (R) : Boiling point of liquid inside the pressure cooker is raised.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**.

(2) **(A)** is correct but **(R)** is not correct.

(3) **(A)** is not correct but **(R)** is correct.

(4) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.

4. Given below are two statements; one is labelled as **Assertion (A)** and the other is labelled as **Reason(R)**.

Assertion (A) : Isotonic solutions does not show net phenomenon of osmosis.

Reason (R) : Isotonic solutions have equal osmotic pressure.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A).**

(2) **(A)** is correct but **(R)** is not correct.

(3) **(A)** is not correct but **(R)** is correct.

(4) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A).**

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5. Consider the following statements :-

(a) For different gases Henry constant is different at same temperature.

(b) Higer the value of Henry constant at a given pressure lower is the solubility of the gas in the liquid

(c) Henry constant is a function of the nature of gas

(d) Henry constant does not depend on temperature.

Which statement is/are not CORRECT.

(1) (a), (b), (c) (2) (a), (b)

(3) (d) (4) (a), (c)

6. Consider following statements :-

(a) Azeotropes are mixture having the same composition in liquid and vapour phase.

(b) It is not possible to separate the components of azeotropes by fractional distillation.

(c) Azeotropic mixture is ideal solution.

(d) Solutions which have large positive deviation from Raoult law form minimum boiling azeotrope.

Which statement is/are correct.

(1) (a), (b), (c) (2) (a), (b), (d)

(3) (a), (c) (4) (c), (d)

7. Consider following statements :-

(a) Isotonic solution does not show net phenomenon of osmosis

(b) Isotonic solution does not show flow of solvent

(c) Isotonic solution have equal osmotic pressure

(d) Osmotic pressure depend on temperature.

Which is/are correct statements

(1) a, b

(2) a, c, d

(3) b, d

(4) b, c

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8. Match the column

	Column-I		**Column-II**
(I)	Van't Hoff factor for dissociation	(a)	More than 1
(II)	Van't Hoff factor for association	(b)	Less than 1
(III)	Van't Hoff factor for non electrolyte	(c)	May be greater than 1 or less than 1.
(IV)	Van't Hoff factor for electrolyte	(d)	Equal to 1

Which is correct :-

(1) (I) → (a), (II) → (d), (III) → (c), (IV) → (b)

(2) (I) → (d), (II) → (b), (III) → (a), (IV) → (c)

(3) (I) → (b), (II) → (c), (III) → (a), (IV) → (d)

(4) (I) → (a), (II) → (b), (III) → (d), (IV) → (c)

9. Given below are two statements; one is labelled as **Assertion (A)** and the other is labelled as **Reason(R)**.

Assertion (A) : The molarity and normality of a solution of K_2CO_3 are same.

Reason (R) : Normality is the product of molarity and valency factor.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A).**

(2) **(A)** is correct but **(R)** is not correct.

(3) **(A)** is not correct but **(R)** is correct.

(4) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A).**

10. Consider following statements.

(a) Ideal solutions are one which obeys Raoult's law at all temperature & concentration

(b) Very dilute solution can be treated as ideal solution.

(c) Ideal solution form azeotropic mixture

(d) Azeotropic mixture are not constant boiling mixture.

Which are correct :-

(1) a, b (2) b, c (3) a, c (4) c, d

11. Consider following statement :-

(a) Molarity depends on temperature

(b) Molality does not depend on temperature

(c) On dilution, concentration of solution will be increased

(d) Sum of the mole fraction of all the components present in a solution are unity

Which is/are incorrect :-

(1) a, c (2) a, d

(3) b, c (4) only c

12. Which are correct statements.

(a) Henry law tells effect of pressure on solubility of gas at given temperature.

(b) Solubility of gas increases on increasing pressure.

(c) Solubility of gas increases with increasing temperature.

(d) Henry's law is not applicable for only non-reactive gas

(1) a, b (2) b, c (3) c, d (4) a, c

13. Which is correct statement :-

(1) Colligative properties depend on chemical nature of solute.

(2) Colligative properties depend on relative number of solute particles.

(3) Colligative properties are same for electrolyte and nonelectrolyte solute solution.

(4) Osmosis is a colligative property.

14. Which is correct statement :-

(1) Solute and solvent molecules pass through SPM.

(2) Only solute molecules pass through SPM.

(3) Only solvent molecules pass through SPM

(4) Neither solute nor solvent pass through SPM

15. Formula of Van't Hoff factor will be :-

(1) $i = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$

(2) $i = \frac{\text{Theoretical colligative property}}{\text{Observed colligative property}}$

(3) $i = \frac{\text{Abnormal molar mass}}{\text{Normal molar mass}}$

(4) $i = \frac{\text{No. of mole of particles before association or dissociation}}{\text{No. of mole of particle after association or dissociation}}$

16. Which are colligative properties

(1) Boiling point, osmotic pressure

(2) Freezing point and osmosis

(3) Elevation in boiling point and osmotic pressure

(4) Vapour pressure and depression in freezing point

17. Consider the following statements.

(a) Molal depression constant depend on the nature of solvent.

(b) Elevation in boiling point for dilute solution is directly proportional to molality.

(c) The unit of molal depression constant is K kg eq^{-1}.

(d) Molality is the function of temperature.

Which are correct statement.

(1) a, b (2) b, c (3) c, d (4) a, d

18. Which is correct statement

(1) Osmotic pressure of 1M glucose solution and 1 M KCl solution will be same

(2) Osmotic pressure of 1 M NaCl solution and 1 M KCl solution will be same

(3) RLVP for 1M Na_2CO_3 solution and 0.5 M KCl solution will be same

(4) Vapour pressure does not depend on temperature

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19. Consider following statements.

(a) The solution which obey Raoult's law over entire range of concentration and temperature are called ideal solutions.

(b) The enthalpy of mixing of the pure components to form the ideal solution is zero.

(c) The volume of binary solution would not be equal to the sum of volumes of two components.

(d) Solution of n-hexane and n-heptane is ideal solution.

Which are correct:-

(1) a, c (2) a, b, d

(3) c, d (4) b, c

20. Consider following statements.

(a) A solution is a homogeneous mixture. of two or more substances

(b) Effect of pressure on the dissolution of gas in a liquid is governed by Henry's law

(c) The extent to which a solute is dissociated or associated can be expressed by van't Hoff factor (i)

(d) Van't Hoff factor for electrolyte is always greater than 1

Which are correct statements.

(1) a, b (2) c, d

(3) a, d (4) b, d

EXERCISE-III (Analytical Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	4	4	4	4	3	2	2	4	3	1	4	1	2	3	1
Question	16	17	18	19	20										
Answer	3	1	2	2	1										

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Important Notes